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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Aerial Photography dating from 1937 to 1978 was used to show loss and alteration of freshwater tidal wetland habitat associated with Hunting Creek, Fairfax County, Virginia. In 1937 there were more than 36 ha of viable tidal marsh and swamp bordered by farmland in the study area. There is now a straight stream channel bordered by high-rise apartment buildings and an interstate highway in the study area, with only limited wetlands remaining. By analyzing sequential aerial photography it is possible to show loss of specific wetlands during separate periods of time, using quick, inexpensive techniques. The method		

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6 CHANGES IN THE WETLANDS OF HUNTING CREEK,
FAIRFAX COUNTY, VIRGINIA

10 GEORGE E. M. NEWBURY, III

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Introduction

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The wetland and deepwater habitats of North America have changed greatly since the colonization by Europeans. Man has drained marshes, filled swamps and laid bare hillsides. Nature has altered sea level and filled bays with sediment eroded from the denuded hillsides. The interaction of man and nature often alters wetlands more quickly than either would when acting separately. The results of the interaction between man and nature may be easily viewed in many areas. One such area is Hunting Creek, Fairfax County and Alexandria City, Virginia (location 36°42' North, 77°02' West).

There are many methods which may be used to map the present distribution of wetland habitat. These include surveying, line transects, and aerial photography. As far back as 1929, aerial photography was used to map soils of entire counties (Bushnell 1929). The use of remote sensing specifically to delineate wetlands became widespread in the last decade, it was found to be a very effective tool to accurately determine state coastal boundaries (Anderson and Wobber 1973). However the same photography used for mapping soils in 1929 may be used today for mapping the wetlands of 1929. Thus aerial photography may be used to map wetland habitats which existed in an area and have since been destroyed.

Although aerial photography will not give clear pictures of the future, its accuracy in portraying previous conditions allows one to more accurately analyze trends and predict future changes. Since many areas of the United States have been photographed from the air frequently since the 1930's, there are detailed historical records available of wetland change. These records are sufficiently detailed to allow classification and quantification of wetland habitat changes over time in units smaller than hectares.

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The purpose of this study is to show the change which has occurred in the wetland habitats of Hunting Creek since 1937 and to demonstrate the use of sequential aerial photography to inexpensively analyze prior change and assist the prediction of future change.

Materials

I initially limited the materials used to inexpensive readily available materials. I used a folding pocket stereoscope, 2.25x magnification, a #00 Rapidograph pen and a #3 Rapidograph pen, Pelikan Special T ink, stable based drawing film, an engineers scale and a dot sample grid. I later used a Numonic planimeter in an attempt to obtain more accurate measurements of wetland habitat areas. However, the total areas differed by less than 3% and most of the wetland classes measured varied less than 10% with either method. I found that counting dots was far quicker.

The aerial photographs used came from a variety of sources. They varied in scale from 1:6,000 to 1:24,000 and, except for 1978 which was color, all years of coverage used were black and white.

Methods

The most important step in remote sensing is often overlooked, that is finding all available photographs. I called many agencies, both state and federal, prior to obtaining photos. Thus I was able to obtain suitable scale, date and quality for my purposes.

To determine the changes in the wetlands and the reasons for these changes, I used a two step approach. The first step was the regional analysis, I selected the earliest and latest years of aerial photographic index sheets, of the watershed, which I had on hand. I then used line transects to determine the percentage of watershed which was in either forest, agriculture or built-up area (Kramer and Sturgeon 1942). This sampling took approximately fifteen minutes for each index sheet.

The second step was the local analysis. I examined each set of photos and selected the earliest (1937) and a recent (1978) set for detailed analysis. The earliest was selected as a base point for determining change. The 1978 set was selected because it was 1:6,000 scale and the latest year (1979) was 1:24,000. I then mapped wetland areas on both sets, using intervening years of photography as supplementary knowledge. Patterns were broken out based on position with respect to tidal water, elevation, tone and texture and were classified according to Cowardin, et al 1979. The analysis of the photos took approximately two hours.

Results and Discussion

The parent materials for the soils of the Hunting Creek watershed are a metamorphic rock in the upper watershed and Coastal Plain sediments in the lower watershed. The upper watershed weathers to fine sands and clayey silts, while the lower is mixed clay, silt, sand and gravel. The climate is temperate, with an average annual precipitation of 104 cm. and an average annual temperature of 14°C (Parsons, Brinckerhoff, Quade and Douglas, Inc. 1974). The combined effect of adequate, and occasionally intense, rainfall with the local soils creates erosion problems when the soil is exposed.

The forests which dominated the area until the late 1600's maintained vegetative cover. In the early years the area grew slowly, its economic base being tobacco and later corn and wheat. In 1879 there were 425 buildings plus 4 grain mills and a sawmill in the Cameron Run watershed (which is everything upstream of the tidal portion of Hunting Creek) and the population of Fairfax County was 16,025 persons (Table 1) (Netherton, et al 1978, Parsons, Brinckerhoff, Quade and Douglas, Inc. 1974).

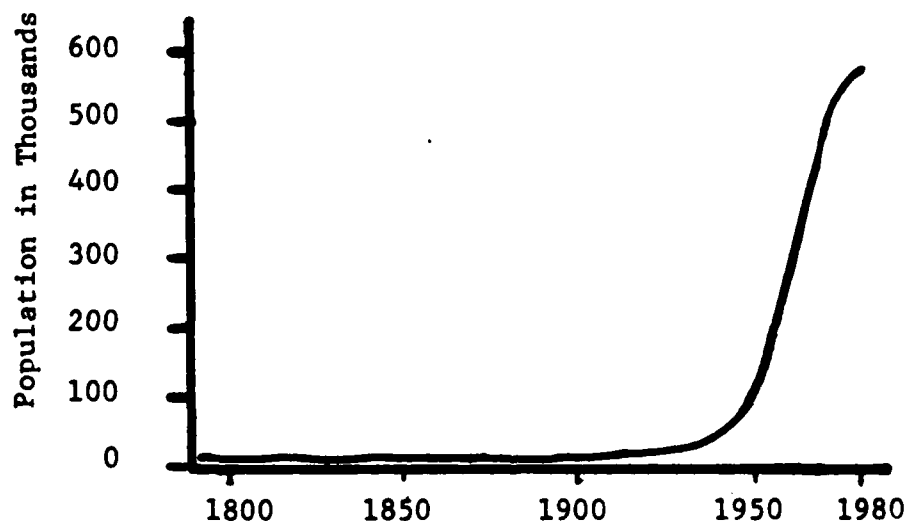


Table 1 - Population Growth - Fairfax County 1790-1980
(Netherton et al 1978, Fairfax County Library, personal communication)

The population continued to grow slowly from 1880 to 1930 adding about 2,000 persons per decade. From 1930 to 1940 the population grew by 15,665 persons.

When the entire county was first "flown" in 1937, the population growth rate was accelerating, having just doubled

between 1790 and 1930 (Table 1). Thus the 1937 photography provides an environmental baseline for conditions which had changed slightly since the early 19th century. Sampling of the 1937 aerial photograph index sheets indicates that the land use of the watershed was divided between forest and agriculture, with less than 1% of the watershed built up (Table 2).

COMPARISON OF LAND USE IN HUNTING CREEK WATERSHED
1937 and 1963

	FOREST	AGRICULTURE	BUILT UP
1937	49%	45%	6%
1963	27%	14%	58%

Forested = Covered by trees or shrubs.

Agriculture = Fields, golf courses, cemeteries and other grassy areas.

Built up = Dense housing, industry, large areas under construction.

Table 2 - Land Use

The watershed had become a suburb of Washington, DC by 1963. Sampling of the 1963 photo index sheet indicated that new residential and industrial construction had covered a great percentage of former agricultural and forested land since 1937. In addition a regional transportation system (under construction) was evident which directly affected Hunting Creek.

A study of the watershed in 1974 found that 73.5 percent of the Fairfax County portion of the watershed was developed (Parsons, Brinckerhoff, Quade and Douglas, Inc. 1974).

In 1979 the sewer shed of Cameron Run had a population of 134,278 people residing in 46,687 housing units. Under the Fairfax County Comprehensive Plan of 1975 there will be maximum of 59,348 housing units in the sewer shed, a further increase of 27% (Fairfax County 1979). Thus it seems that eventually the forested land and farm land will equal the area of built up land in 1937.

The study of the index sheets and correlation of data concerning historic, present and future land use indicates that habitat change would have occurred in the Hunting Creek wetlands due to sedimentation caused by an increased rate upland erosion. When mature forest cover is removed and intensive agriculture replaces it, the sediment yield of a stream may increase threefold (Ritter 1978).

A change from intensive agriculture, to suburban development further increases the sediment load. The modern suburban construction practices generally involve complete removal of all vegetation and topsoil, and constant heavy vehicle and bulldozer traffic. All measures which greatly increase the rate of erosion. Those steps toward urbanization may increase sediment yield threefold over intensive agriculture (Ritter 1978). Thus tobacco, corn and wheat farming increased the sediment load of Hunting Creek and began filling in the mouth of the creek. From the 1940's on, construction activities further increased the sediment load. The period from 1950 to 1980 probably is the period of greatest erosion the watershed has undergone or will undergo since it became forested.

The regional analysis indicates the forcing factors in the local system. The tidal portion of Hunting Creek once was sufficiently deep for warehouses which had wharves near the present location of the Route 1 and Interstate 95 intersection (Figure 1). In 1884 a channel 40 feet wide and 6 feet deep (12 meters by 1.8 meters) was dredged from the wharves to the Potomac River by private parties (House of Representatives 1903). In 1896 the mouth of Hunting Creek was 1.5 meters deep at mean low water (USC&GS 1896). In 1902 the tidal portion was described as follows:

"The depth of water in the estuary ranges generally from 2 to 5 feet at low tide, becoming gradually shoaler as one proceeds up the creek; it is not a deep creek obstructed by a bar at the mouth, but one continuous shoal. The estuary is almost entirely covered with a dense growth of aquatic plants and the flats above with wild rice."
(House of Representatives 1903)

In 1936 the mouth of Hunting Creek was shallow, only 0.9 to 1.2 meters in depth at mean low water downstream of Mount Vernon Highway and 0.6 to 0.9 meters deep between Mount Vernon Highway and Route 1 (USC&GS 1936). On April 30, 1937 the first aerial coverage recorded the wetland habitats for posterity (Figure 2). My interpretation shows a total of 236 ha of wetland habitat (Table 3). The vegetation at the time of photography was just beginning its growing season, the trees and shrubs were probably fully leafed out and most of the non-persistent emergents should have emerged. Field trips in 1980 and 1981 indicated that the persistent emergents were only starting to grow at the end of April, while the non-persistent emergents were often half grown.

DOMINANT HABITAT GROUP	1937		1978		CHANGE (ha) 1937-1978
	HECTARES	% TOTAL	HECTARES	% TOTAL	
RIUB	144	61	66	53	-122
RIUS	34	14	46	37	+ 12
RIEM	22	9	4	3	- 18
PEM	13	6	2	1	- 11
PSS	7	3	5	4	- 2
PFO	16	7	2	2	- 14
TOTAL	236	100	125	100	-109

Table 3. Comparison of wetland habitat, NWI classification system, subsystem and class, all numbers rounded to hectare (raw data grouped to class level of dominant subsystem).

Photographs taken in 1953, 1963, and 1977 were also obtained but overlays were not made and I did not measure wetland habitat. The 1953 photography showed little changes from the 1937 photography. A marina was built on the north shore east of Mount Vernon Memorial Highway and here was a slight increase in the emergent wetland near the Route 1 bridge. Comparison of the 1936 and 1953 nautical charts indicate the slight marsh change and the marina, in addition they show a channel dredged to 1.8 meters (6 feet) from the new marina to the Potomac River (USC&GS 1953). The 1963 photography shows great change from the 1937 and 1953 photography. In 1963 Interstate 495 (now Interstate 95) was under construction. Hunting Creek was channelized and 77 ha of wetlands upstream of Route 1 were destroyed by draining, filling and channelization. During this time the construction was confined to the north shore of the tidal creek. However the south shore was being filled at the same time and 50% of the wetlands between Route 1 and Mount Vernon Memorial Highway were altered to golf course and built up land. The marina on the north shore appeared to be in good condition, although navigation charts indicate the channel was the same depth as much of the creek to the south (1.2m) (USC&GS 1962).

In 1977 the conditions were much the same as the 1978 photos. I did not examine the 1977 photos but they did show the full channelization of Hunting Creek for its entire tidal portion. Thus a quick examination of several years of coverage showed that construction of a major transportation routes, filling of wetland and channelization of the stream had occurred. Correlation with navigation charts showed that the creek mouth had been filling in prior to the construction and fill by man.

In 1978 Fairfax County obtained color aerial photography of the entire county. Examination of the prints

which cover the lower tidal portion of Hunting Creek provided very recent information on the distribution of present and former wetland habitats. By 1978 a hotel, gas station, a new car dealership, and 4 new holes on the golf course, had replaced approximately 37 ha of riverine and palustrine tidal habitat. Approximately 70 hectares were lost due to channelization and highway construction (Fig. 3).

However by 1978 the portion of Hunting Creek east of Mount Vernon Highway had built up with sediments and areas that were 1.5 m below mean low water in 1896 were exposed in 1978 (USC&GS 1896, NOS 1978). This greatly increased the area of riverine unconsolidated shore habitat, at the expense of riverine unconsolidated bottom habitat.

Overall almost 50% of the wetland habitat in existence in 1937 had been removed from the system by 1978. The remaining habitat is 90% mudflat and creek bottom, compared to 75% in 1937. Approximately 45 hectares of marsh and swamp have been lost, and these areas were valuable wildlife habitat. Considering only the riverine emergent class (dominated by Nuphar, Peltandra, Pontedaria) and the palustrine emergent class (dominated by Typha), it appears that there has been a loss in annual productivity since 1937 of approximately 2×10^6 kilograms for the tidal portion of Hunting Creek (based on productivity of 1 metric ton per hectare) (Doumlele 1979).

Based on study of the photographs and building projections of Fairfax County, I would predict that the mudflats at the mouth of Hunting Creek will continue to build up, although at a slower rate than the past 10 years. The upstream channelization combined with the vast area of parking lots, roof tops and other impervious surface should increase peak flows and scour the lighter sediments from the upstream channel. These sediments will be deposited at the mouth of the creek and may eventually build an emergent marsh. In the two years I have been watching the marsh, there has been an increase in the number of tree stumps and old tires on the mudflats. If these stabilize small areas of sediment, it is probable that emergent and floating leaved vegetation will colonize these areas which were almost deep water in 1896.

Summary

Aerial photography was used as a basis to monitor wetland habitat alteration between 1937 and 1978 in Hunting Creek, Fairfax County, Virginia. The use of a regional analysis, which combined historical information with analysis of aerial photo index sheets, showed major changes in the land use of the watershed. Sampling of the index sheets was quick and showed actual ratio of forested, agricultural

and built up land. The regional analysis indicated construction in the watershed would drastically increase sediment load in the creek. Analysis of photography covering Hunting Creek showed actual change of specific wetland habitat due both to construction and sedimentation at the creek mouth. The regional analysis provided evidence for the causes of present and future habitat change in the mouth of Hunting Creek, using readily available historical information and one half hour spent sampling the photo index sheets. The detailed analysis provided actual habitat area for both 1937 and 1978 and took approximately two hours. Based upon the present projections of construction activity it is expected that sedimentation will continue to fill in the creek mouth and build a riverine tidal emergent marsh where there is presently a riverine unconsolidated shore and there used to be a riverine unconsolidated bottom.

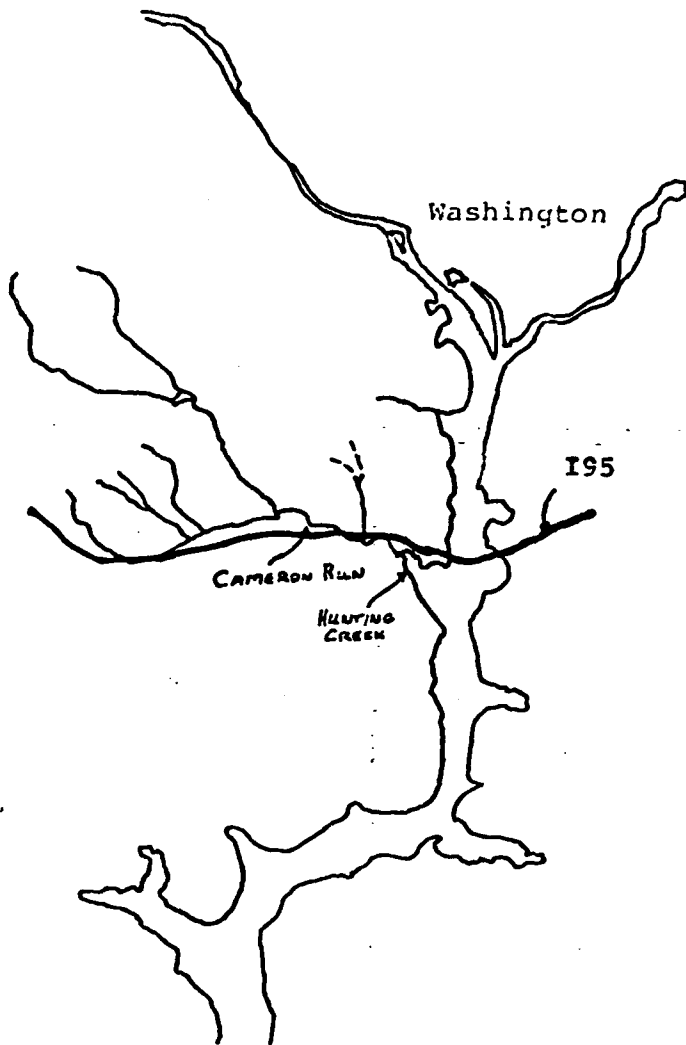


Figure 1. Location of Hunting Creek, Fairfax County, Virginia.

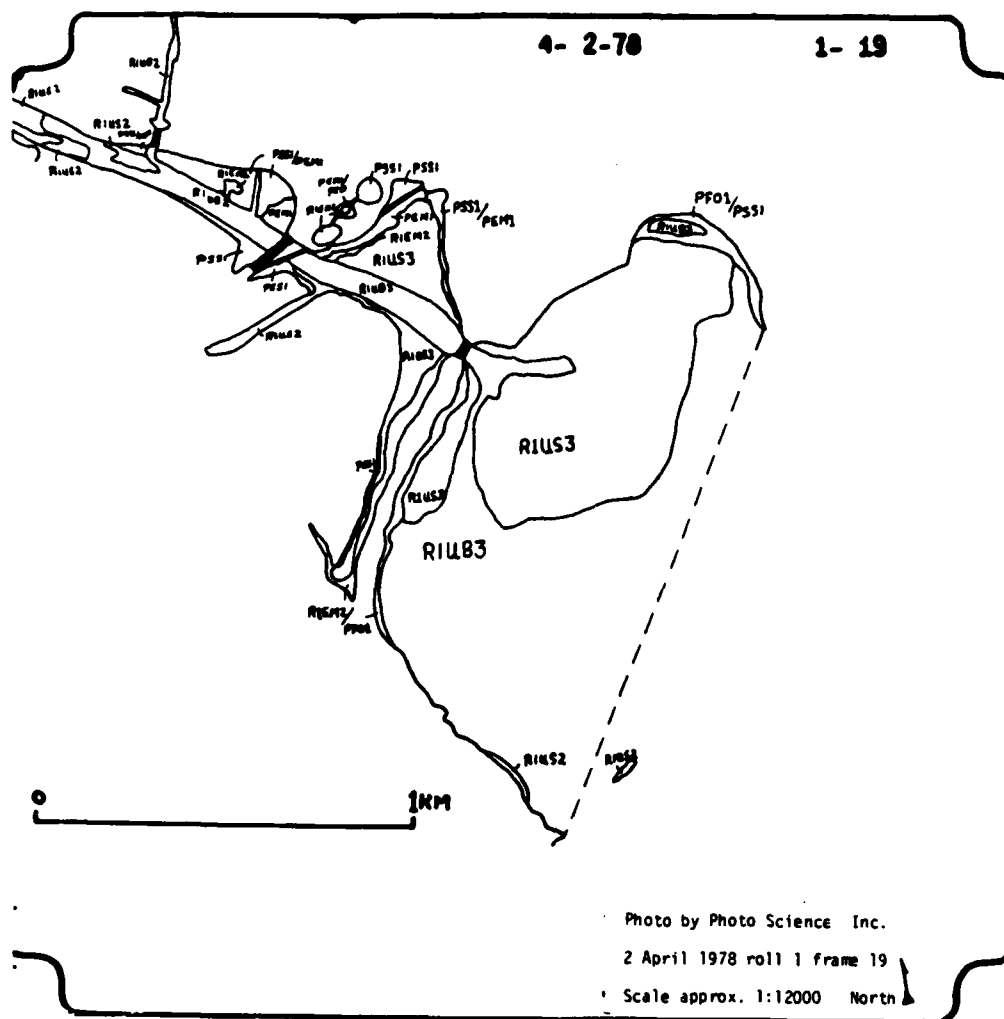


Figure 3 - Spatial Patterning of wetlands
in Hunting Creek, Virginia 1978, Classified
according to National Wetlands Inventory

AERIAL PHOTOGRAPHS USED

<u>YEAR</u>	<u>SCALE</u>	<u>SOURCE</u>
1937	1:20,000	National Archives and Records Service, Washington, DC
1953	1:20,000	Fairfax County Planning Dept., Fairfax, Virginia
1963	1:12,000	Dept. of Photography, Virginia Dept. of Highways, Richmond, VA
1977	1:24,000	Same as 1963
1978	1:12,000 (Color)	Photo Science, Inc., Gaithersburg, Maryland
1979	1:24,000	Same as 1963

AERIAL PHOTO INDEX SHEETS

<u>YEAR</u>	<u>SOURCE</u>
1937	National Archives and Records Service, Washington, DC
1963	U. S. Dept. of Agriculture, ASCS, Salt Lake City, Utah

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